DOCUMENT RESUME

ED 192 265 CS 005 636

AUTHOR Meyer, Bonnie J. F.; Rice, G. Elizabeth
TITLE Signaling in Text.
INSTITUTION Arizona State Univ., Tempe.
SPONS AGENCY National Inst. of Mental Health (DHEW), Bethesda, Md.
PUB DATE Sep 80
GRANT NIMH/ROI-MH-31520-C1
NOTE 18p.; Paper presented at the Annual Meeting of the American Psychological Association (Montreal, Canada, September 1-5, 1980).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Discourse Analysis; *Function Words; *Models; Organization; *Readability; *Reading Comprehension; *Surface Structure

ABSTRACT

A model is proposed that attempts to provide some order for the disparate findings with respect to the effects of signaling in text on recall. The type of signaling examined is that which explicitly cues the relationships among the major propositions in the text structure. It is noted that while it is generally assumed that such signaling is an aid to the reader, few studies have shown differences in recall for versions of texts with and without signaling. The model proposed recognizes signaling to be one factor in a series of interacting reader and text variables that affect recall. Thus, the relative effects of signaling on recall are seen to be dependent on such reader attributes as ability to use the "structure strategy" in reading, adequacy of text organization skills, and the difficulty level of the text. (Data on ninth grade student and adult readers are considered in support of the model.) (Author/RL)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED192265

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

SIGNALING IN TEXT

Bonnie J. F. Meyer and G. Elizabeth Rice

Arizona State University

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Bonnie J.F. Meyer
G. Elizabeth Rice

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

This paper was presented at American Psychological Association Convention in Montreal, Quebec, Canada, September 1980, as part of a symposium entitled *Text Dimensions that Influence Cognitive Processing*. Preparation of this paper was supported in part by the National Institute of Mental Health, DHEW Research Grant NIMH/ROI MH 31520-01 and an Arizona State University Faculty Grant. Requests for reprints should be sent to Bonnie J. F. Meyer, Department of Educational Psychology, Arizona State University, Tempe, Arizona 85281.

CS005636

SIGNALING IN TEXT

A model is proposed which attempts to provide some order for the disparate findings with respect to the effects of signaling in text on recall. The type of signaling examined is that which explicitly cues the relationships among the major propositions in the text structure. While it is generally assumed that such signaling is an aid to the reader, few studies have shown differences in recall for with- and without-signaling versions of texts. The model proposed recognizes signaling to be one factor in a series of interacting reader and text variables which affect recall. Thus, the relative effects of signaling on recall are seen to be dependent on such reader attributes as ability to use the "structure strategy" in reading, and adequacy of text organization skills as well as the difficulty level of the text. Data on readers from ninth grade to adult are considered.

A significant educational issue centers on how readers determine what information is important to remember from text. Since capacity limitations make it impossible for people to remember everything from what they read, there must be selectivity in processing and forgetting information. This selective process frequently is guided by such features of a text as structure and emphasis. Manipulations of text structure, emphasis devices, and their interactions have been shown to affect quantity and quality of recall. This paper examines the interaction between text which varies in emphasis placed on its overall logical structure (signaling) and certain reader attributes.

Background Definitions

Text Structure

The "text structure" specifies the interrelationships among items of information which compose the text, as well as indicating the subordination and coordination of this information (Meyer, 1975, 1977, 1979). Thus, a text structure provides an organizational structure which can be used during reading for understanding information and judging its importance. As an example, Figure 1 depicts the superordinate conceptual structure of an article about supertankers. Propositions at the top third of the total text structure correspond to what has commonly been called a text's message; the middle third corresponds to major details which support the premises of the message, and the bottom third corresponds to minor details (Meyer, 1979; Meyer, Brandt, & Bluth, in press). The text structure (depicted from the

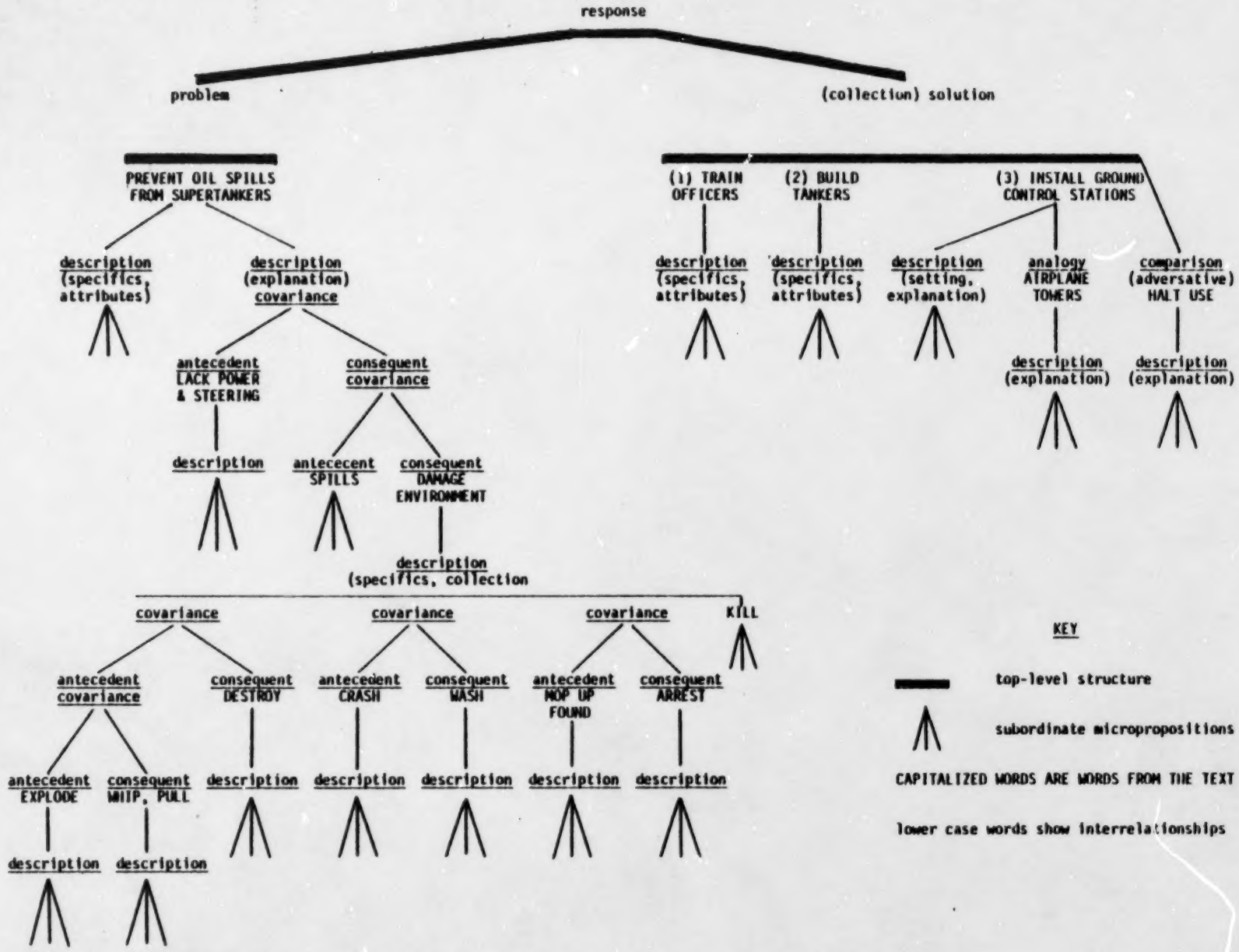

Figure 1. Superordinate structure of relationships of a magazine article on supertankers.

author's perspective) highlights that information which is interrelated by its superordinate structure, while it de-emphasizes information interrelated at lower levels (Meyer, 1975).

Emphasis devices, such as typography, graphics, questions, objectives, and signaling, can parallel the importance hierarchy of the text structure or highlight information from lower levels in the structure. As seen in Table 1, variations in the match between text structure and emphasis patterns differentially affect the reading performance of students with different reading skill levels (Meyer, in press). The present paper deals only with well-organized, hierarchically structured exposition where structure and emphasis, namely signaling, are compatible (see the first column in Table 1).

Table 1

Relationships Between Reading Skill of Student and Match Between Structure of Hierarchically Organized Text and Emphasis Device (Signaling, Typography, Graphics, Objectives, Questions, and Illustrations)

	Content Highlighted by Text Structure and Emphasis Device	
Reading Skill of Student	Match	No Match
Proficient	No Effects	Effects
Poor in Comprehension/ Adequate in Decoding	Effects	Effects
Poor in Comprehension and Decoding	No Effects	No Effects

No Effects = no differences in recall between text with- and without-signaling.

Effects = differences in recall between text with- and without-signaling.

Signaling

Signaling has been defined as information in text which does not add new content about a topic, but which gives emphasis to certain aspects of the semantic content or points out aspects of the structure of the content (Meyer, 1975). The types of signaling which have been identified include explicit statement of the structure of relations in the text structure, preview statements, summary statements, and pointer words or evaluative signaling. The studies to be discussed in this paper involve only signaling of the first variety, the structure of relationships, and only signaled relationships among major propositions. In some of these studies where recall from passages with- and without-signaling have been compared, signaling words have been deleted in the without-signaling versions, reducing the total number of words. In other of the studies, the signaling words have been deleted, but the number of words in the with- and without-signaling version has been kept constant by adding articles, reducing sentence length, and repeating words.

The signaled relationships at the superordinate level in the structure are rhetorical relationships: comparison, causal, description, collection, problem/solution (response), general/specific. (For examples, refer to Figure 1.) Signaling of these relationships explicitly points them out to readers; examples of signaling for comparison relationships include "in contrast," "however," "but," and "on the other hand" and for causal relationships they include "therefore," "as a result," "so that," "in order to," and "because." (Also, see Appendix A for examples.) If signaling is not provided by a writer, then the reader must infer an appropriate logical relationship among propositions. The type of signaling investigated in this paper is parallel to Halliday and Hasan's (1976) conjunction cohesion; however, it is examined at the macroproposition level where it interrelates groups of sentences and paragraphs rather than clauses and sentences at the microporposition level of text structure.

Disparate findings have been reported from studies (Britton, Meyer, Glynn, & Penland, Note 1; Marshall & Glock, 1979; Meyer, 1975, in press, Note 2; Meyer, Brandt, & Bluth, in press) which have examined the effects on recall of signaling the logical relationships in text. In this paper, we will attempt to make sense out of these conflicting data. Figure 2 presents the model which we will use to explain these findings.

The model is limited to text which presents propositions that are interrelated logically in a hierarchical organization. This includes most expository and narrative text, but not text which primarily presents a collection of descriptions of a topic. In descriptive text (Flower, 1979; see attribution discourse type in Meyer, 1977; Meyer & Freedle, Note 3) the structure is more linear and list-like than hierarchical.

The model is also limited to adolescents and adults who are attending school. It may generalize to younger children; but the studies have only dealt with ninth graders to graduate students. Our data from middle (40-54 years) and older adults (65 and older), who are no longer attending

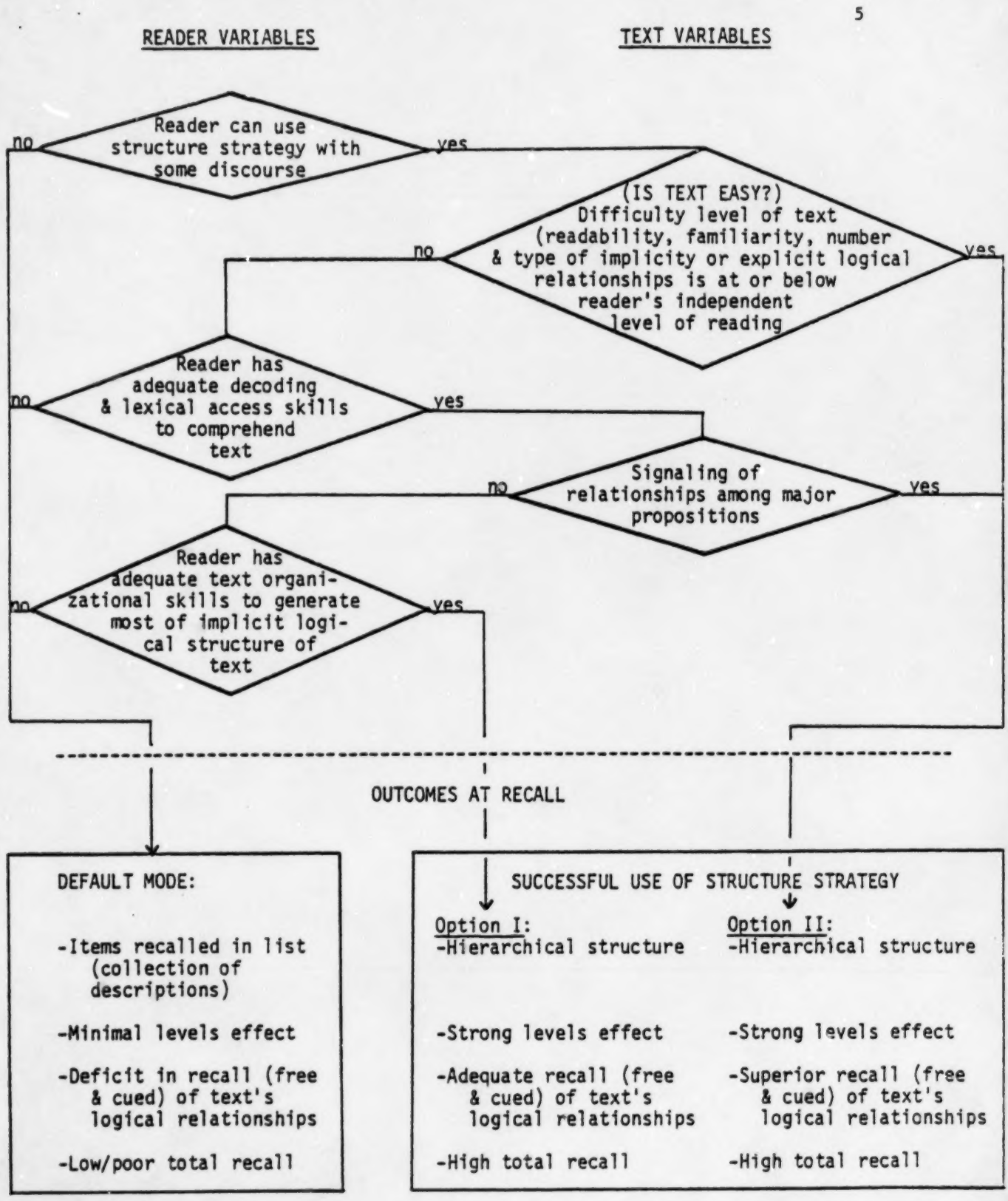
READER VARIABLES
TEXT VARIABLES
Reader can use structure strategy with some discourse
no
yes
(IS TEXT EASY?) Difficulty level of text (readability, familiarity, number & type of implicity or explicit logical relationships is at or below reader's independent level of reading
no
yes
Reader has adequate decoding & lexical access skills to comprehend text
no
yes
Signaling of relationships among major propositions
no
yes
Reader has adequate text organizational skills to generate most of implicit logical structure of text
no
yes
OUTCOMES AT RECALL
DEFAULT MODE:
-Items recalled in list (collection of descriptions)
-Minimal levels effect
-Deficit in recall (free & cued) of text's logical relationships
-Low/poor total recall
SUCCESSFUL USE OF STRUCTURE STRATEGY
Option I:
-Hierarchical structure
-Strong levels effect
-Adequate recall (free & cued) of text's logical relationships
-High total recall
Option II:
-Hierarchical structure
-Strong levels effect
-Superior recall (free & cued) of text's logical relationships
-High total recall

Figure 2. Model depicting the interaction of reader text variables which affect quality and quantity of recall from hierarchically organized text.

school, suggest that these adults may use strategies for selecting types of information from text to remember (Meyer, Note 2; Meyer & Rice, Note 4) which differ from the strategy implicitly or explicitly taught in most contemporary schools (i.e., DeBoer & Dallmann, 1960), the *structure strategy*.

The Structure Strategy: Follow the Text's Superordinate Relational Structure; Focus on the Text's Message and How It Relates to Supporting Major Details

The structure strategy has been substantially documented in recent years; it appears to be the dominant strategy employed in prose learning studies by proficient readers at the high school, college, and university levels. Its outcome is superior recall of information high in the text structure as compared to low level information (Kintsch & Keenan, 1973; Mandler & Johnson, 1977; Meyer, 1971, 1975, 1977, 1979; Meyer & McConkie, 1973; Thorndyke, 1977); this has been termed the levels effect (Kintsch & van Dijk, 1978). Also, the superordinate relational structure of the recall protocols produced by deployment of this strategy is similar to that of the text (Meyer, 1979; Meyer & Freedle, Note 4). That is, both the protocol and original text have the same top-level structure (such as problem/solution--see Figure 1) and most of the same major supporting relationships (such as the causal and comparison relationships in Figure 1). This strategy is also related to comparatively high levels of overall recall (Meyer, 1979).

Processing activities hypothesized to be involved in the structure strategy are similar to those in the explanations given for the levels effect by Anderson (1976) and Kintsch and van Dijk (1978), except that primary emphasis is placed on a search for interrelationships among chunks of complex propositions in text. Anderson (1976) explained that high level propositions, i.e., central propositions in the network of this computer simulation model, are more frequently called up to help interpret the more peripheral low level propositions. This constitutes extra rehearsal of high level propositions and results in increasing the probability of their recall. Similarly, Kintsch and van Dijk (1978) explained that high level propositions are processed differently than low level propositions. High level propositions are hypothesized to be more frequently retrieved from long-term memory and kept in the short-term memory buffer as old propositions to be related to incoming new propositions in the reading process. In the Kintsch and van Dijk (1978) model, high level propositions are identified by repetition of arguments or concepts. The model does not specify how the extreme superordinate proposition is identified; this proposition is crucial since repetition of its arguments dictate moving down in the hierarchy and building the text structure. At present the superordinate proposition is selected on an intuitive basis in the Kintsch and van Dijk model with the expectation that further work with their macroprocesses component will help to explicate this choice.

The superordinate rhetorical relationships in text in combination with readers' prior knowledge of these forms of relationships appear to

play a crucial role in comprehension (Bartlett, 1978; Meyer, 1979) and must be integrated more fully into the macroprocesses component of the Kintsch and van Dijk model. High level propositions need not be identified solely on argument repetition, but they can be identified as the arguments of the most superordinate rhetorical relationship or top-level text structure. The extreme superordinate proposition is then identified as the content bound by the top-level structure. For example in the first paragraphs of the passage reproduced in Appendix A, the extreme superordinate proposition is "oil spills." It is explicitly signaled as the "problem" in the first sentence of this passage, and the passage as a whole is written with a problem/solution top-level structure commonly found in scientific articles. Thus, a focus on relationships and top-level structures can be used to specify the superordinate proposition in a structural analysis.

Processing activities used by the structure strategy search for the major text-based relationships among propositions. Readers employing the structure strategy are hypothesized to approach text looking for patterns which will tie together the propositions contained in the text; in addition, they search for the author's primary thesis which will provide the content to be bound by these patterns or schemata. Then, they search for relationships among this primary thesis and supporting details. For example, when reading the supertanker text, readers employing this strategy recognize in the first sentence that the propositions may fit what they recognize from their prior knowledge as a "problem" schema. Each new proposition is related back to the "problem," making the problem of oil spills from supertankers continually selected for retention in the short-term memory buffer for interpreting the new propositions. Readers' previous knowledge about problems keeps them searching for causal relationships in descriptive information which is given about the problem, such as why it is a problem and what caused it. Also, prior experience with problems leads readers to anticipate and search for solutions, solutions which must satisfy most of the previously stated causes of the problem. Thus, the problem and its causes are retrieved continually from long-term storage to the short-term memory buffer for relating to the subsequent propositions in the passage. This additional processing of these superordinate propositions and their interrelationships increases the depth with thich they are processed (Craik & Lockhart, 1972) and the subsequent ease with which they can be retrieved.

For those readers who use the structure strategy, the top-level structure and major interrelationships are also employed to guide retrieval and production of the recall protocol; it is hypothesized to be a top-down retrieval search guided by the structure of relationships. These readers are assumed to construct memory representations of text propositions which are similar in terms of their hierarchical, logical relationships to the content structure depicted in Figure 1; when recalling the text they begin their retrieval search with the top-level structure and systematically work from the superordinate relationships and content downward. The organization of a protocol written by a student employing the structure strategy matches the top-level structure of the text.

Understanding Signaling Effects: The Model and the Data

Figure 2 examines the factors contributing to the success of readers in employing the structure strategy. The outcome of successfully applying this strategy as it relates to the resultant recall protocol is listed in the figure: (1) a hierarchical, logical structure similar to that of the text, (2) a strong levels effect, (3) sufficient to superior recall of most of the text's logical relationships, and (4) high total recall scores. The model examines both reader and text factors which influence success in employing this strategy. Signaling is one of the text factors.

The first reader variable in the scheme deals with whether or not the reader can employ the structure strategy with some types of discourse. The ability to employ the structure strategy may develop with mental age and schooling. Freedle (Freedle & Hale, 1979; Freedle, Note 5) suggests that competence with story structure precedes competence with expository text. However, there is considerable variance in the structural complexity of different types of stories. Use of the structure strategy may progress in the following sequence with different discourse types which are equivalent on other difficulty factors: stories, description, antecedent/consequent, problem/solution, and comparison (argumentative text). If a reader cannot employ the structure strategy with a simple story, then the model shows the other factors are not considered and the reader can be expected to perform in the default mode. The default approach to learning and memory of hierarchical text is devoid of a systematic plan for processing text; the reader has no focus and simply tries to remember something from the text. Recall outcomes from this non-strategy are listed in the figure: (1) the protocol is organized in a list format, a collection of unrelated descriptions about the passage topic, (2) the levels effects is minimal, (3) recall of the text's logical relationships is poor, and (4) total recall scores are low.

The next factor in the scheme is the difficulty level of the text to-be-read; that is, is the text easy for a particular reader? Aspects of difficulty level include familiarity with the topic, readability, and the type and number of implicit or explicit logical relationships. If the reader can employ the structure strategy with some prose and this particular text easily matches his/her competencies, then the structure strategy will be successfully employed (see II in Figure 2).

With this combination of reader and text factors, there would be no expected effects in a study manipulating signaling in text. This may explain the lack of signaling effects with proficient readers in studies by Britton, Meyer, Glynn, and Penland (Note 1), Marshall and Glock (1978-1979), Meyer (1975, 1979), and Meyer, Brandt, and Bluth (in press). The first three studies utilized college students and found no effects on total recall from manipulating signaling. Meyer (1975) also found no significant signaling effects for signaled relationships with college students. In addition, Meyer, Brandt, and Bluth found no signaling effects with ninth-grade expository text for ninth-grade students with high reading comprehension

test scores (median percentile of 84 on the comprehension test of the Stanford Achievement Test). However, Marshall and Glock, using the same expository passages with junior college students found superiority in total recall from the signaled passages. None of the extant studies for any samples have reported signaling to affect reading time.

The next variable in the model is adequacy of decoding and lexical access skills (Golinkoff, 1974-1975). If a particular text is above a reader's independent reading level, it may be at his/her instructional level or frustration level. If the reader does not have adequate decoding and lexical access skills to comprehend at a single-word level, then the default mode is the outcome. For these students, signaling would be expected to have no effects. In the Meyer, Brandt, and Bluth (in press) study, signaling had no effect on poor comprehenders (median percentile of 32 on the comprehension subtest of the SAT).

The next text variable in the model is signaling of relationships among major propositions. If students with adequate decoding and lexical access skills read text with signaling, then they will successfully employ the structure strategies (II, Figure 2).

However, if signaling is not present, the model shows two possible outcomes depending on the text organization (Golinkoff, 1974-1975) skills of the reader. If these skills are adequate for generating many of the major implicit logical relationships in the structure of the text, then the structure strategy will be employed. The recall outcome will match option I of the structure strategy. The protocol will exhibit a hierarchical structure and strong levels effect but will be slightly diminished on the other two outcomes in comparison to option II (see Figure 2) due to a failure in generating as many of the text's relationships. On the other hand, if text organization skills are not adequate, then the default mode will result.

Evidence for the first outcome comes from data recently collected on 164 adults who read with- and without-signaling versions of the Supertanker Passage shown in Appendix A. Most of these subjects have above average vocabulary test scores, at least some college education, but vary in age and current involvement in school. These data are depicted in Table 2; this is a preliminary look at the data and further analyses require stratification on age, schooling, and vocabulary performance. However, the model would explain these data for over 80% of the subjects as following the paths shown on the model in Figure 3.

On the other hand, when text organization skills are inadequate, large differences would be expected between students reading text with- and without-signaling (see Figure 4). In the Meyer, Brandt, and Bluth (in press) study, signaling effects were examined with a shorter version of the Supertanker Passage. Signaling was expected to assist students with adequate word knowledge and word attack skills, but poorer reading comprehension skills (i.e., underachievers). Twenty-six of these students were identified in one teacher's five classes of ninth-grade English. The

Table 2

Results from Preliminary Analyses of the Data Collected on Adult Readers Who Read the Supertanker Passage With- and Without-Signaling

Recall Outcomes	Signaling	
	With--	Without-
% Hierarchically Organized	88%	85%
Levels Effect	High > Low $p < .00001$	High > Low $p < .00001$
Recall of Logical Relations (N = 14) ($p < .001$)	8.25	6.86
Total Recall ($p < .07$)	37%	33%

stanine score of each of these students on the reading comprehension scale of the SAT was at least one stanine below their stanine score on the vocabulary scale. In addition, in order for students to be selected for this subgroup, their stanine scores on the vocabulary scale had to be 4 or greater. The median percentile score on the reading comprehension scale for this group was 43, while their median percentile score on the vocabulary scale was 60. Thus, they were a subgroup of Cromer's (1970) difference readers. This study reported statistically significant differences in immediate total recall scores between underachievers who read passages with signaling ($\bar{X}_{mean} = 49$) and those who read passages without-signaling ($\bar{X} = 33$).

In conclusion, the model provides some order to the disparate and surprising findings from studies which have studied signaling of text relationships. Composition teachers have traditionally encouraged writers' use of signaling and have assumed that they aided their readers. At first glance, the lack of dramatic signaling effects for most readers seems surprising. However, the effects of signaling appear to interact with the competency of students in using the structure strategy and the difficulty level of the text.

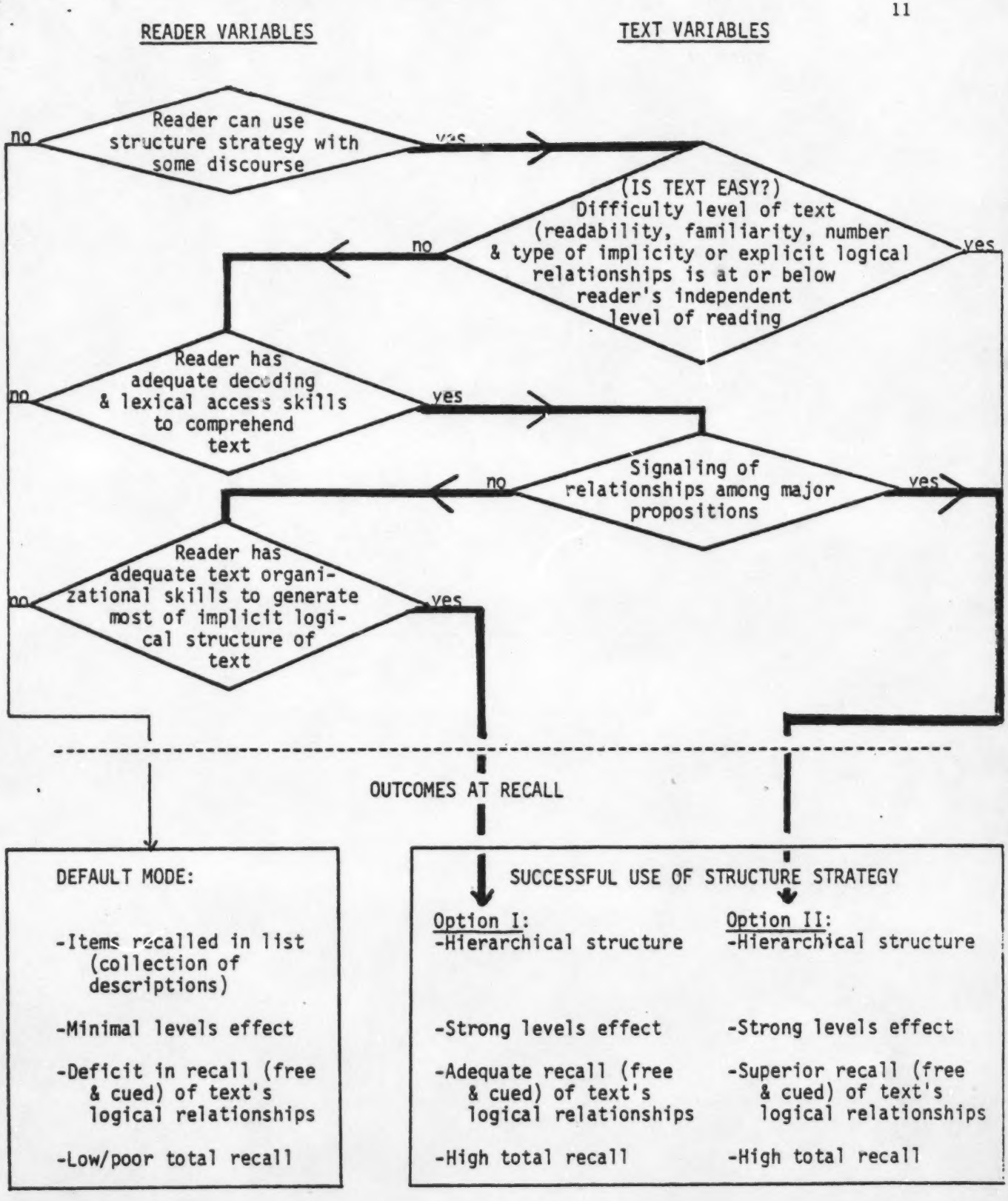
READER VARIABLES
TEXT VARIABLES
Reader can use structure strategy with some discourse
no
yes
(IS TEXT EASY?) Difficulty level of text (readability, familiarity, number & type of implicity or explicit logical relationships is at or below reader's independent level of reading
no
yes
Reader has adequate decoding & lexical access skills to comprehend text
no
yes
Signaling of relationships among major propositions
no
yes
Reader has adequate text organizational skills to generate most of implicit logical structure of text
no
yes
OUTCOMES AT RECALL
DEFAULT MODE:
-Items recalled in list (collection of descriptions)
-Minimal levels effect
-Deficit in recall (free & cued) of text's logical relationships
-Low/poor total recall
SUCCESSFUL USE OF STRUCTURE STRATEGY
Option I:
-Hierarchical structure
-Strong levels effect
-Adequate recall (free & cued) of text's logical relationships
-High total recall
Option II:
-Hierarchical structure
-Strong levels effect
-Superior recall (free & cued) of text's logical relationships
-High total recall

Figure 3. Explanation of signaling effects with 154 adult readers.

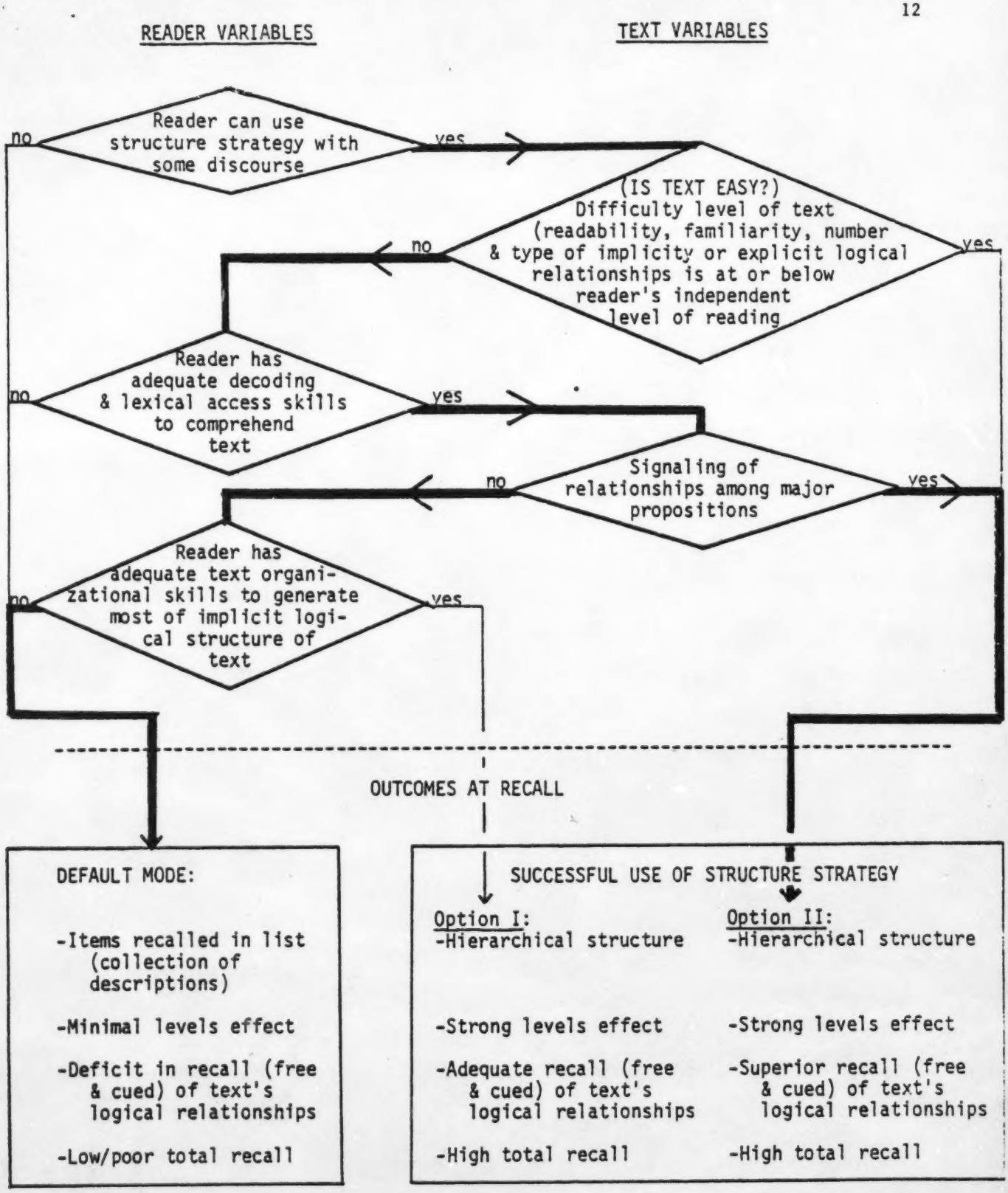
READER VARIABLES
TEXT VARIABLES
Reader can use structure strategy with some discourse
no
yes
(IS TEXT EASY?) Difficulty level of text (readability, familiarity, number & type of implicity or explicit logical relationships is at or below reader's independent level of reading
no
yes
Reader has adequate decoding & lexical access skills to comprehend text
no
yes
Signaling of relationships among major propositions
no
yes
Reader has adequate text organizational skills to generate most of implicit logical structure of text
no
yes
OUTCOMES AT RECALL
DEFAULT MODE:
-Items recalled in list (collection of descriptions)
-Minimal levels effect
-Deficit in recall (free & cued) of text's logical relationships
-Low/poor total recall
SUCCESSFUL USE OF STRUCTURE STRATEGY
Option I:
-Hierarchical structure
-Strong levels effect
-Adequate recall (free & cued) of text's logical relationships
-High total recall
Option II:
-Hierarchical structure
-Strong levels effect
-Superior recall (free & cued) of text's logical relationships
-High total recall

Figure 4. Explanation of the data from the Meyer, Brandt, and Bluth study with underachievers in reading comprehension.

Reference Notes

1. Britton, B. K., Meyer, B. J. F., Glynn, S., & Penland, M. J. *Use of cognitive capacity in reading: Effects of signaling in text.* Unpublished manuscript, University of Georgia, 1979.

2. Meyer, B. J. F. *Signaling in text and its interaction with reader strategies.* Paper presented in a symposium entitled "Graphic and linguistic features of text as an aid to comprehension" at the annual meeting of the American Educational Research Association, Boston, April 1980.

3. Meyer, B. J. F., & Freedle, R. O. *The effects of different discourse types on recall* (Prose Learning Series #6). Tempe, Ariz.: Arizona State University, Department of Educational Psychology, 1979.

4. Meyer, B. J. F., & Rice, G. E. *The amount, type, and organization of information recalled from prose by young, middle, and old adult readers.* Unpublished manuscript, Department of Educational Psychology, Arizona State University, 1980.

5. Freedle, R. O. *Children's recall of narrative and expository prose: The acquisition of an expository schema.* Paper presented at the annual meeting of the American Educational Research Association, Boston, April 1980.

References

Anderson, J. P. *Language, memory, and thought.* Hillsdale, N.J.: Lawrence Erlbaum Associates, 1976.

Bartlett, B. J. *Top-level structure as an organizational strategy for recall of classroom text.* Unpublished doctoral dissertation, Arizona State University, 1978.

Craik, F. I. M., & Lockhart, R. S. Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior,* 1972, *11,* 671-684.

Cromer, W. The difference model: A new explanation for some reading difficulties. *Journal of Educational Psychology,* 1970, *61,* 471-488.

DeBoer, J. J., & Dallmann, M. *The teaching of reading.* New York: Holt, Rinehart & Winston, 1960. Pp. 135-136.

Flower, L. Writer-based prose: A cognitive basis for problems in writing. *College English,* 1979, *41,* 19-37.

Freedle, R. O., & Hale, G. Acquisition of new comprehension schemata for expository prose by transfer of narrative schema. In R. O. Freedle (Ed.), *New directions in discourse processing*. Norwood, N.J.: Ablex, 1979.

Golinkoff, R. M. A comparison of reading comprehension processes in good and poor comprehenders. *Reading Research Quarterly*, 1975-1976, *11*, 623-659.

Halliday, M. A. K., & Hasan, R. *Cohesion in English*. London: Longman, 1976.

Kintsch, W., & Keenan, J. M. Reading rate as a function of number of propositions in the base structure of sentences. *Cognitive Psychology*, 1973, *6*, 257-274.

Kintsch, W., & van Dijk, T. A. Toward a model of text comprehension and production. *Psychological Review*, 1978, *85*, 363-394.

Mandler, J. M., & Johnson, N. S. Remembrance of things parsed: Story structure and recall. *Cognitive Psychology*, 1977, *9*, 111-151.

Marshall, N., & Glock, M. D. Comprehension of connected discourse: A study into the relationships between the structure of text and information recalled. *Reading Research Quarterly*, 1978-1979, *14*, 10-56.

Meyer, B. J. F. *Idea units recalled from prose in relation to their position in the logical structure, importance, stability, and order in the passage*. Unpublished master's thesis, Cornell University, 1971.

Meyer, B. J. F. *The organization of prose and its effects on memory*. Amsterdam: North-Holland Publishing Co., 1975.

Meyer, B. J. F. The structure of prose: Effects on learning and memory and implications for educational practice. In R. C. Anderson, R. Spiro, & W. E. Montague (Eds.), *Schooling and the acquisition of knowledge*. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Meyer, B. J. F. Organizational patterns in prose and their use in reading. In M. L. Kamil & A. J. Moe (Eds.), *Reading research: Studies and applications*. Clemson, S.C.: National Reading Conference, Inc., 1979. Pp. 109-117.

Meyer, B. J. F. A selected review and discussion of basic research on prose comprehension. In D. F. Fisher & C. W. Peters (Eds.), *Comprehension and the competent reader*. Newark, Del.: International Reading Association, in press.

Meyer, B. J. F., Brandt, D. M., & Bluth, G. J. Use of the top-level structure in text: Key for reading comprehension of ninth-grade students. *Reading Research Quarterly*, in press.

Meyer, B. J. F., & McConkie, G. W. What is recalled after hearing a passage? *Journal of Educational Psychology*, 1973, *65*, 109-117.

Thorndyke, P. W. Cognitive structures in comprehension and memory of narrative discourse. *Cognitive Psychology*, 1977, *9*, 77-110.

Appendix A

A signaled version of the supertanker passage:
Signaling shown with italics and overall
structure depicted in Figure 1

Some Solutions for the Supertanker Problem

A *problem* is prevention of oil spills from supertankers. *Attributes* of a *typical* supertanker include carrying capacity of a half-million tons of oil, size of five football fields, and cargo areas easily accommodating the Empire State Building. *The trouble is that* a wrecked supertanker spills oil in the ocean. *As a result of spillage* the environment is damaged. *An example* took place in 1970 near Spain when an oil spill from a wrecked tanker exploded into fire. *The fire caused* hurricane-force winds which whipped the oil into a mist and pulled all of it high into the air. Several days later black rain *resulting* from this oil spill destroyed crops and livestock in the neighboring villages. *Another example of damage* occurred in 1967 when the tanker, Torrey Canyon, crashed off the coast of Cornwall and *resulted* in the washing ashore of 200,000 dead seabirds. *An example* which happened nearer to home came to pass in July 1975 when the United States Coast Guard mopped up acres of oil from the beach at Geiger Key, Florida, north of Key West. Guardsmen found chemical clues *which led to* the arrest on November 7, 1975 of a Greek tanker captain, Vasilios K. Psarroulis, *because of* failure to report the loss of an estimated 40,000 gallons of oil. Oil spills *also* kill microscopic plant life *which* provide food for sea life and produce 70 percent of the world's oxygen supply.

Most wrecks result from the lack of power and steering equipment to handle emergency situations, *such as* storms. Supertankers have only one boiler to provide power and one propeller to drive the ship.

The *solution to the problem is not* to halt the use of tankers on the ocean *since* about 80 percent of the world's oil supply is carried by supertankers. *Instead, the solution lies in the following three facts. First,* officers of the supertankers must get top training in how to run and maneuver their ships, *such as that* provided by the tanker simulator at the Maritime Research Center. *Second,* tankers should be built with several propellers for extra control and backup boilers for emergency power. *Third,* ground control stations should be installed at places where supertankers come close to shore *because* they would act like airplane control towers, guiding tankers along busy shipping lanes and through dangerous channels.